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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/702,048	11/06/2003	Noriaki Fukiage	FIS920060072US1 (RAJ-013)	7394
James Klekotka Suite 10 4350 W. Chandler Blvd. Chandler, AZ 85226	7590 01/17/2008		EXAMINER TADAYYON ESLAMI, TABASSOM	
			ART UNIT 1792	PAPER NUMBER
			MAIL DATE 01/17/2008	DELIVERY MODE PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

10/702,048

Applicant(s)

FUKIAGE ET AL.

Examiner

Tabassom T. Tadayyon-Eslami

Art Unit

1792

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 06 November 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-41 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-41 is/are rejected.
- 7) ☐ Claim(s) _____

is/are objected to.

- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/ are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>03/11/2005</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim 2 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The term "small foot" is not defined in the specification and is a relative term.

Claim 19 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention. The term "another processing gas" referred to gas comprising silicon-containing and carbon -containing precursor (based on claim 15) and is not the same as inert gas.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1- 9, 20- 21, 23, 27-29, 31-36 and 41 are rejected under 35 U.S.C. 102(b) as being anticipated by M. Angeopoulos et. al. (U. S. Patent: 6316167, here after 167).

Claim 1 is rejected. 167 teaches,

a method for depositing a material on a substrate, comprises,

placing a substrate in a chamber having a plasma source and on a substrate holder [column 9 line 65];

depositing a TERA layer on the substrate [column 8 line 58, (SiCH)]. The fact that the processing gas (tetramethylsilane) is not amine-based precursor (as is disclosed in 0046 of application the amine based precursor react with resist), and in fact the applicant use this precursor [0055 line 11]). Therefore, the precursor chosen to reduce reaction with a photoresist.

Claim 2 is rejected. Since the application is to fabricate IC's and in nm size, [column 1 lines 1-3, column 1 lines 29-33], therefore the photoresist features should be about nm and are very small (also please see column 5 lines 10-13).

Claim 3 is rejected. 167 teaches forming plurality of photoresist features on the photoresist compatible surface and she further teaches the feature comprises a well defined rectangle profile [fig. 10].

Claim 4 is rejected. 167 teaches the limitation of claim 1 as discussed above and since she use the same precursor to form the TERA layer as the applicant use (tetramethylsilane) [column 8 line 60] underneath the photoresist layer, therefore it is inherent that it matches (reduce chemical reaction) with the resist and prevent formation of footings on the photoreist features [fig. 8 and column 5 lines 10-13] and the photoresist on the top portion also has rectangular profile [fig. 8].

Claim 5 is rejected. 167 teaches the limitation of claim 1 as discussed above and she further teaches isolating a bottom portion(layer 1) of the TERA layer from the photoresist with a top portion of the TERA layer(layer 3) [fig. 2B], thereby reducing the formation of footing on photoresist features in a photoresist layer [fig. 8, column 5 lines 10-13].

Claim 6 is rejected. 167 teaches the limitation of claim 1 as discussed above and she further teaches providing a chemically inactive layer (TERA layer) between a chemically active layer (the substrate or the silicon dioxide layer) [column 8 line 37] and a photoresist layer [fig. 2B], wherein the precursor is chosen to create a dielectric material (SiCH) [column 8 line s 57-60] that does not chemically react with the photoresist layer.

Claim 7 is rejected. 167 teaches the limitation of claim 1 as discussed above and she further teaches the top portion of the TERA layer have a chemically inert surface [SiCH, column 10 lines 54-56] with plurality of rectangular photoresist features [Fig. 8].

Claim 8 is rejected. 167 teaches the limitation of claim 1 as discussed above and she further teaches there is no chemical interaction and therefore resist poisoning [column 10 lines 45-49] between the TERA layer [column 10 lines 54-56] and plurality of photoresist features having substantially rectangular profiles can be formed on the TERA layer [fig. 8].

Claim 9 is rejected. 167 teaches the limitation of claim 1 as discussed above and it further teaches,

a method of depositing material on a substrate wherein the depositing TERA layer during a depositing time comprises a material having a refractive index (n) of 2.1 and extinction coefficient of 0.5 [column 12 line 58-59, first layer] measured at the wavelength of 248 nm [column 12 lines 30 and 64].

Claim 31 is rejected. 167 teach the limitation of claim 27 and she further teaches the inert gas to be argon [column 9 line 21].

Claims 20 and 21 are rejected. 167 teaches the limitation of claim 9 and 167 teaches controlling the pressure of the chamber and the pressure in the range of 0.2 torr [column 8 line 61].

Claim 23 is rejected. 167 teaches limitation of claim 1 and she further teaches depositing a top portion of the TERA layer, wherein the top portion comprises a material having a refractive index of 1.9 and extinction coefficient of 0.25, when measured at a wavelength of 248 nm [column 12 line 61].

Claims 27 and 28 are rejected. 167 teaches limitation of claim 23 and she further teaches the process gas comprises silicon, carbon, oxygen and argon containing gas [column 9 line 21].

Claim 29 is rejected. 167 teaches the limitation of claim 27 as discussed above and she further teaches the precursor flowed with the rate of 10 sccm [column 8 line 59] and the inert flowed with the rate of 30sccm [column 9 line 22].

Claim 32 is rejected. 167 teaches the limitation of claim 28 as discussed above and she further teaches the processing gas comprises tetramethylsilane (4MS) [column 8 line 60].

Claim 33 is rejected. 167 teaches the limitation of claim 32 and she further teaches controlling the chamber pressure to be lower than 3 torr [column 8 line 58].

Claims 34-35 are rejected. 167 teaches the limitation of claim 32 and 33 and she further teaches depositing the TERA layer (top portion) comprises controlling the temperature of the substrate to greater than 300 C [column 10 lines 1-2].

Claim 36 is rejected. 167 teaches the limitation of claim 1 and she further teaches controlling the substrate temperature at 60 °C [column 8 line 62].

Claim 41 is rejected. 167 teaches a method for depositing a material on a substrate, the method comprising:

Placing a substrate in a chamber having plasma source and on a substrate holder [column 9 line 65];

Depositing (tunable) layers of materials on the surface [fig. 2B]. Depositing a first portion of a TERA layer on the substrate, wherein a first processing gas comprising first precursor is provided to the chamber (the deposition is via PECVD, therefore it is inside a chamber) [column 9 lines 65-68] and depositing a second processing gas comprising a second precursor is provided to the chamber, wherein the second precursor is chosen to reduce reaction with a photoresist [column 10 lines 7-9, column 10 lines 53-57].

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 15-17 and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over M. Angeopoulos et. al. (U. S. Patent: 6316167, here after 167).

Claims 15 and 17 are rejected. 167 teaches the limitation of claim 9 and she further teaches another process gas comprises silicon and carbon containing precursor (trimethylsilane, 3MS) [column 9 line 6]. Since 167 teaches depositing top and bottom part of TERA layer, the precursor can be chose independent from each other. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention was made to have a method of deposition

of TERA layer where the bottom part is depositing by tetramethylsilane precursor and the top portion is deposited by trimethylsilane precursor, because 167 teaches it is suitable to deposit the TERA layer with these precursors.

Claim 16 is rejected. 167 teaches the limitation of claim 15 and she further teaches silicon containing and carbon containing precursor with the rate of 10 sccm [column 8 line 60].

Claim 19 is rejected. 167 teach the limitation of claims 15 and she further teaches the inert gas to be argon [column 9 line 21].

Claims 10-12, 18 and 25-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over M. Angeopoulos et. al. (U. S. Patent: 6316167, here after 167) further in view of Hounng T. Nguyen et. a. (U. S. Patent application: 2003/0017694, here after 694).

Claim 11 is rejected. 167 teaches the limitation of claim 1 as discussed above, she teaches a method of deposition a TERA layer (comprises Si, C, O, H) [column 4 lines 12-24] on a substrate. 167 does not specifically teach the deposit rate of the bottom portion of the TERA layer is about 100-10000 A/ min. 694 teaches a method of deposition of organosilicate layers [abstract lines 1-2] wherein the deposit rate of the organosilicate material is in the range of 1000-20000 A/ min [0055 lines 12-14]. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention was made to have a method of deposition of TERA layer in which the deposition rate of the TERA layer is 100-10000 A/ min, because 694 teaches it is suitable to deposit TERA layer with these deposition rate.

Claims 10 and 12 are rejected. 167 teaches a method of deposition a TERA layer (comprises Si, C, O, H) [column 4 lines 12-24] on a substrate. 167 does not specifically teach the deposition time for depositing the bottom layer is between 5-18 seconds. 694 teaches a method

of deposition of organosilicate layers [abstract lines 1-2] wherein the deposit rate of the organosilicate material is 20000 A/ min [0055 lines 12-14]. He further teaches the thickness of the layer is about 3000 A [0057 lines 4]. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention was made to have a method of deposition of TERA layer in which the deposition time of the bottom TERA layer is about 9 sec, because 694 teaches within this time the thickness of the TERA layer is appropriate.

Claim 18 is rejected. 167 teaches the limitation of claim 15 as discussed above and she further teaches a method of deposition a TERA layer (comprises Si, C, O, H) [column 4 lines 12-24] on a substrate which meets the limitation of claim 15 as discussed above. 167 does not specifically teach the processing gas comprises CH₄. 694 teaches a method of deposition of organosilicate layers [abstract lines 1-2] wherein the processing gas comprises CH₄ [0053 line 3]. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention was made to have a method of deposition of TERA layer in which the processing gas comprises CH₄, because 694 teaches methane is a suitable gas for deposition of organosilicate layer.

Claim 25 is rejected for the same reason claim 11 is rejected [also see 0064 lines 2-5].

Claim 26 is rejected for the same reason claim 12 is rejected [also see 0064 lines 2-5].

Claims 13-14 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over M. Angeopoulos et. al. (U. S. Patent: 6316167, here after 167) further in view of Seon Mee Cho et. al. (U. S. Patent Application: 2003/0003768, here after Cho).

Claim 13 and 24 are rejected. 167 teaches the limitation of claims 1 and 23 as discussed above and she further teaches a method of deposition a TERA layer (comprises Si, C, O, H) [column 4 lines 12-24] on a substrate which meets the limitation of claims 1, 10 and 24 as

discussed above. 167 does not specifically teach the plasma source has a RF source. Cho teaches a method of deposition of organosilicate layers [0016 lines 1-4] wherein the plasma source (11) has a RF source in a power range of 10 watt/ cm² to about 200 watt/ cm² [0038, lines 3-5] frequency of 13.56 MHz [0037 lines 5-6 and 11-15]. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention was made to have a method of deposition of TERA layer in which the plasma source has a RF has the power of 1 watt/ cm² to about 500 watt/ cm², 13.56 MHz frequency, because Cho teaches it is suitable to deposit TERA layer with having RF plasma source.

Claim 14 is rejected. 167 teaches the imitation of claim 13 as discussed above and she further teaches a method of deposition a TERA layer (comprises Si, C, O, H) [column 4 lines 12-24] on a substrate which meets the limitation of claims 1 and 10 as discussed above. 167 does not specifically teach the substrate holder is coupled to a RF source. Cho teaches a method of deposition of organosilicate layers [0016 lines 1-4] wherein the substrate holder (12) [0035 lines 11-13] is coupled to a second RF source [00033 lines 8-23] of 0.3-3.2 watt/ cm² [0035 lines 12-13] and frequency of 0.1-200 MHz [0033 lines 16-17]. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention was made to have a method of deposition of TERA layer in which the plasma source has a RF has the power of 0.3-3.2 watt/ cm² and frequency of 0.1-200 MHz, because Cho teaches it is suitable to deposit TERA layer with having RF plasma source.

Claim 30 is rejected under 35 U.S.C. 103(a) as being unpatentable over M. Angeopoulos et. al. (U. S. Patent: 6316167, here after 167), further in view of A. Grill, Journal of Applied Physics, Vol. 93 (2003) 1785-1790, here after Grill.

167 teaches limitation of claim 27, as discussed in the 35 U.S.C. 102(b) rejection above. 167 does not teach the precursor comprises TMCTS. Grill teaches a method for depositing SiCOH by PECVD when the precursor is TMCTS [column 2 line 4 and 27, page 1785] (mixing with inert gas (column 1 line 6 page 1786). Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention was made to have a method for depositing SiCOH film via PECVD that 167 teaches when the precursor is TMCTS, because Grill teaches it is suitable to use TMCTS for depositing SiCOH film via PECVD process.

Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over M. Angeopoulos et. al. (U. S. Patent: 6316167, here after 167) further in view of Craig A. Roderick (U. S. Patent: 6074488, here after 488). 167 teaches the limitation of claim 9 as discussed in the 35 U.S.C. 102(b) rejection above. 167 does not teach the DC voltage is applied to an electrostatic chuck. 488 teaches a method of plasma deposition [column 10 lines 42-46] where a DC voltage applied to the electrostatic chuck [column 2 lines 58-60]. He further teaches the DC voltage is about 200-2000 Volts [claim 32]. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention was made to have a method of plasma deposition wherein the DC voltage to an electrostatic chuck of about 200-2000 Volts to hold the substrate and generate plasma, because 488 teaches it is desirable to deposit material on a surface by such a plasma processing to eliminate extraneous components [column 2, lines 55-65].

Claims 37-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over M. Angeopoulos et. al. (U. S. Patent: 6316167, here after 167) further in view of Tae K. Won (U. S. Patent Application: 2003/0044621, here after Won). 167 teaches a method of deposition a TERA layer (comprises Si, C, O, H) [column 4 lines 12-24] on a substrate which meets the limitation of

claim 1, as discussed in the 35 U.S.C. 102(b) rejection above, 167 does not teach controlling the chamber wall temperature. Won teaches a method of deposition of organosilicate layers [abstract lines 7-9] wherein where the chamber wall temperature is controlled [0051 lines 11 to the end] in order to obtain uniform film [claim 2 lines 7-10], he further teaches the temperature is between 380-410 °C [claim 2 line 9-10]. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention was made to have a method of deposition of TERA layer in which chamber wall temperature is controlled and is between 380-410 C, because Won teaches the deposited film will be uniform with controlling the chamber temperature between 380-410 C.

Claim 39 is rejected under 35 U.S.C. 103(a) as being unpatentable over M. Angeopoulos et. al. (U. S. Patent: 6316167, here after 167) further in view of Zheng Yuan (U. S. Application: 2002/0163028, here after Yuan). 167 teaches the limitation of claim 1, as discussed in the 35 U.S.C. 102(b) rejection above. She further teaches a shower head assembly is coupled to the chamber [120 fig. 2 and 0027 lines 3-5], She does not specifically teaches the temperature of the showerhead. Yuan teaches a method for depositing film on a substrate [abstract lines 1-2, 0007 lines 1-4], where the temperature of showerhead is about 90-120 C [0040 lines 3-12], to enhance the reaction time between the species. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention was made to have a method of deposition of TERA layer in which the showerhead temperature is controlled and is between 90-120 C, because Yuan teaches it enhance the reaction time between the species.

Claim 40 is rejected under 35 U.S.C. 103(a) as being unpatentable over M. Angeopoulos et. al. (U. S. Patent: 6316167, here after 167) and Enzo Carollo (U. S. Patent Application: 2004/0137169, here after Carollo) as applied to claim 38 above, further in view of Zheng Yuan

(U. S. Application: 2002/0163028, here after Yuan). 167 and Carollo teach the limitation of claim 38, as discussed above. 167 further teaches a shower head assembly is coupled to the chamber [120 fig. 2 and 0027 lines 3-5], 167 does not specifically teaches the temperature of the showerhead. Yuan teaches a method for depositing film on a substrate [abstract lines.1-2, 0007 lines 1-4], where the temperature of showerhead is about 90-120 C [0040 lines 3-12], to enhance the reaction time between the species. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention was made to have a method of deposition of TERA layer in which the showerhead temperature is controlled and is between 90-120 C, because Yuan teaches it enhance the reaction time between the species.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tabassom T. Tadayyon-Eslami whose telephone number is 571-270-1885. The examiner can normally be reached on 7:30-5.


If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Cleveland can be reached on 571-272-1418. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Application/Control Number:
10/702,048
Art Unit: 1792

Page 13

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T.T


MICHAEL CLEVELAND
SUPERVISORY PATENT EXAMINER